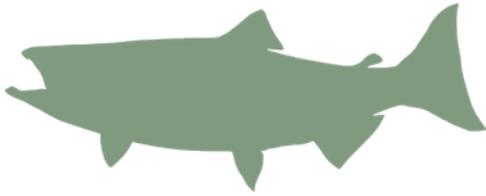


The Salmon Life Cycle



Overview:

The anadromous life history strategy of salmon plays a key role in bringing nutrients from the ocean back into rivers and the wildlife community.

Though it varies among the species of Pacific salmon, in its simplest form, it is hatch, migrate, spawn, die.



Eggs & Alevins

The cycle begins in freshwater, when a redd, or a female's nest of eggs, is fertilized. These eggs remain in the gravel throughout the winter, and the embryos develop. In the spring, the eggs hatch and alevins emerge. These are tiny fish with the yolk sac of the egg attached to their bellies. Alevins stay close to the redd for a few months. When they have consumed all of the yolk sac and grown in size, these fish emerge from the gravel, and are then considered fry.



Alevins in gravel
NPS photo

Fry

Fry swim to the surface of the water, fill up their swim bladders with oxygen, and begin to feed. As salmon begin to mature, they adapt for life in salt water in an intermediary stage known as smolts. This process marks the beginning of their first migration from their home stream to the ocean. Fish that move from fresh to salt water and back again over the course of their lives, must be able to change their physiology. Depending on the species, fry can spend up to a year or more in their natal stream. Upon emerging from the gravel, both [pink](#) and [chum](#) are already silvery smolts, and head directly to sea. [Sockeye](#) fry tend to migrate to a lake, spending 1-2 years before migrating to sea. [Chinook](#) fry usually spend less than 5 months in freshwater, while [coho](#) fry may spend over a year.



The survival of fry is dependent upon high-quality stream habitat. Boulders, logs, shade, and access to side channels is important in allowing fry to hide from predators and prevents them from getting flushed downstream during flood river-flows.

A coho fry in the Elwha River
Roger Peters - USFWS

Seaward Migration

Eventually, environmental cues cause fry to begin their migration downstream towards the oceans. Most salmon species spend some time in the estuary of a river, where the freshwater mixes with the salt water. Here, they gradually get used to life in salty water in preparation for the time they will spend at sea. Very few fish can adapt from living in fresh water to salt water, and then return back to fresh water. In a process called smoltification, salmon adapt to the changes salt water causes to their bodies. In fresh water, the salmon's body is saltier than the water in which it swims. To work properly, the body needs salt so it tries to keep the salt in. Some escapes, but the salmon gets enough from the food it eats to make up for the loss. In the ocean, the water is saltier than the salmon's body needs to be, so it must try to keep the salt out and the water in. When salmon swim in the ocean, the saltwater draws water out of the fish's cells. Salmon adapt by drinking sea water to replace the water their cells lose. They excrete the excess salt through their gills and urine. Freshwater fish would die in salt water because they cannot replace the water in their cells. As the smolts prepare for ocean life, their appearance also changes, from the dark colors of the fry to the silvery color of adult salmon. This helps them hide in the light conditions of the surface waters of the open ocean, where there is no dark shade from overhanging trees. In estuaries, the mineral and organic elements of a river mix with ocean nutrients brought in by tides, creating a nutrient-rich environment that supports diverse plant and animal growth. Estuaries provide salmon with a good supply of insects and crustaceans, such as tiny shrimps for food. Estuaries, at the mouth of the river, are crucial to the survival of young smolts. While allowing their bodies to adjust to the new conditions, they feed heavily, hoping to ensure survival in the ocean. The loss of estuary habitat means that there is less room for salmon and other estuary animals to mature, feed and adapt. If smolts cannot live in an estuary, all other plants and animals are at risk, also.



By the end of their seaward migration, the smolts are silvery all over. nps photo

Different species of salmon spend different amounts of time in estuaries. Some leave almost immediately, while others spend several months there. While approximately 30 fry from a redd of 2000 to 2500 eggs grow into smolts, less than four survive to become adults.

Ocean Life

While some salmon remain in coastal water, others migrate northward to feedings grounds. Salmon may spend one to seven years in the ocean. Certain species have more flexible life history strategies, while others are more rigid. Chum may spend up to seven years at sea, but typically four. Pink salmon, on the other hand, spend a fixed 18



Estuaries provides crucial adjustment habitat for salmon leaving and entering the river. nps photo

months at sea. Sockeye typically spend two years at sea, coho spend about 18 months, and chinook can spend up to 8 years before journeying back to their natal streams to spawn.

Spawning Migration

It is unknown how exactly salmon detect their natal streams, though it is suspected that scents and chemical cues, as well as the sun, play an important role in the homeward migration. Once the salmon reach freshwater, they stop feeding. During the course of the journey, their bodies instinctively prepare for spawning. The taxing journey draws energy from their fat storage, muscles, and organs, except for the reproductive organs. Males develop hooked noses, or kype, in order to fight for dominance.



Coho return to spawn in the Sol Duc River. nps photo

Spawning & Death

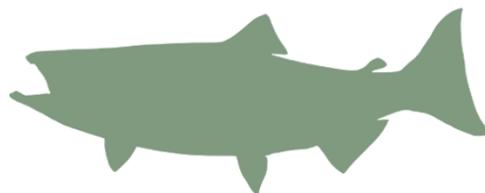
Upon reaching natal streams, females build nests, or redds. These little depressions in the gravel are made by the female by turning on her side and using her tail to dislodge stones or pebbles. Males fight with other males for spawning rights with a female. The dominant male will court the female and upon spawning, they release eggs and milt simultaneously. The eggs will settle into the gravel, and the female will cover the eggs with loose gravel and move upstream in order to prepare another redd. Eventually, both the males and females die, supplying the river habitat with nutrients and the seeds of the next generation that will someday return to continue the cycle.



A deteriorated salmon dies soon after spawning. Eggs lay unburied in the gravel. nps photo

https://home.nps.gov/olymp/learn/nature/the-salmon-life-cycle.htm#CP_JUMP_224851

Last updated: July 22, 2019





WHERE ARE THE SALMON, WHEN?

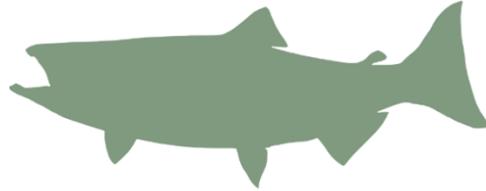
GENERALIZED LIFE HISTORY PATTERNS OF SALMON, STEELHEAD, AND TROUT IN THE PACIFIC NORTHWEST *

	ADULTS RETURN TO STREAMS FROM OCEAN	SPAWNING LOCATION	EGGS IN GRAVEL**	YOUNG IN STREAM	FRESHWATER HABITAT	YOUNG MIGRATE DOWNSTREAM	TIME SPENT IN ESTUARY	TIME SPENT IN OCEAN	ADULT WEIGHT (avg)
COHO	Oct-Jan	coastal streams, shallow tributaries	Oct-May	1+ years	tributaries, main stem side channels, slack water	Mar-July (2nd year)	few days-month	2 years	5-20 lb (8)
CHUM	Sept-Jan	coastal rivers and streams, lower reaches	Sept-Mar	days-weeks	little time spent in freshwater	shortly after young leave gravel	7-14 days	2.5-3 years	8-12 lb (10)
CHINOOK		main stem-- large and small rivers			main stem--large and small rivers		days-months	2-5 years	
Spring run	Jan-July		July- Jan	1+ year		Mar-July (2nd year)			10-20 lb (15)
Summer run	June-mid Aug		Sept-Nov	1+ year		Spring (2nd year)			10-30 lb (14)
Fall run	Aug-March		Sept-Mar	3 - 7 months		April-June (2nd year)			15-40 lb
CUTTHROAT (Coastal- Sea Run)	July-Dec	tiny tributaries of coastal streams	Dec-July	1-3 years (2 avg)	tributaries	Mar-June (of 2nd-4th yr)	less than a month	0.5 - 1 year	0.5-4 lb (1)
PINK	July-Oct	main stem of large and small streams, tributaries, lower reaches	Aug-Jan	days-weeks	little time spent in freshwater	Dec-May	few days	1.5 years	3-10 lb (4)
SOCKEYE	July-Aug	streams, usually near lakes	Aug-April	1-3 years	lakes	April-June (of 2nd-4th yr)	few days	1 - 4 years	3-8 lb (6)
STEELHEAD***		tributaries and small streams and rivers			tributaries		less than a month	1 - 4 years	
winter	Nov-June		Feb-July	1 - 3 years		March-June (of 2nd-5th yr)			5-28 (8)
spring	Feb-June		Dec-May	1 - 2 years		Spring & Summer (of 3rd-4th yr)			5-20
summer	June-Oct (Columbia), April-Nov (coastal)		Feb-June Feb-July	1 - 2 years 1 - 3 years		March-June (of 3rd-5th yr) March-June (of 2nd-5th yr)			5-30 (8)

* There is much variation in life history patterns--each stream system having fish with their own unique timing and patterns of spawning, growth, and migration. You may want to ask a local biologist about the specific patterns of the fish in your streams and update this chart for your area.

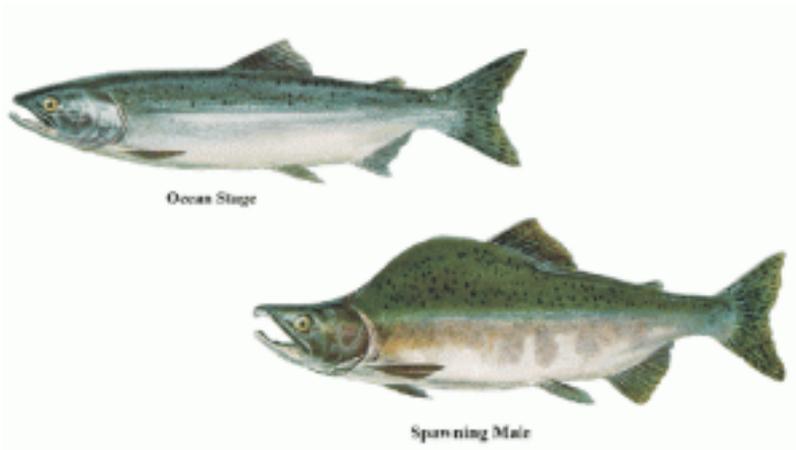
** The eggs of most salmonids take 2-5 months to hatch at the preferred water temperature of 50-55 degrees F.

*** Steelhead and cutthroat trout, unlike salmon, may not die after spawning. They can migrate back out to sea and return in later years to spawn again.



Meet the 7 species of Pacific Salmon

Pink: *Oncorhynchus gorbuscha*



Picture: US Fish and Wildlife Service

Also known as humpies, due to the very large hump males get just behind the head, during the spawning phase.

Although they are the smallest of the species, they are the most abundant in number. They spend the least amount of time in freshwater, spawning very close to the mouth of streams with little to no upstream migration. While in the ocean they appear to have steel blue to blue green backs, silver sides, and a white belly with large oval spots covering their

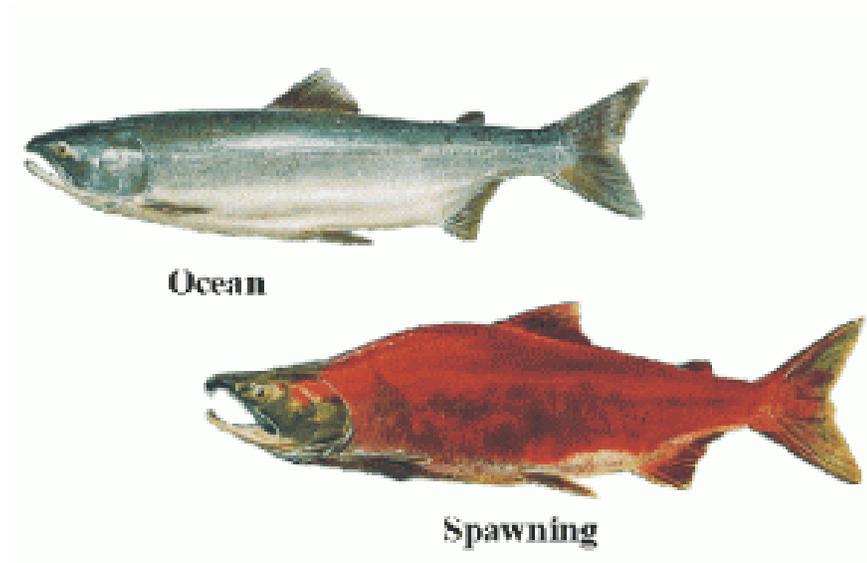
back, adipose fin and both lobes of the caudal fin. During the spawning phase pinks have dark backs with a pinkish wash and green blotches on their sides. These fish generally live for 2 years, are about 18-24in in length, and weigh about 3-5 lbs.

Pink fry do not rear in freshwater. Immediately after emerging they move downstream to the estuary and rear there for several months before heading out to the open ocean. Because of this, pink fry have no spots, which provide camouflage in streams, but are bright chrome for open water.

Pinks use the mainstems of large rivers and some tributaries, often very close to saltwater. Because their fry move directly to sea after emerging, the closer they spawn to saltwater the better. The shorter journey reduces predation and increases survival. Sometimes pink salmon spawn right in saltwater, avoiding freshwater altogether.

Pinks have a very regular life history, living for two years before returning to spawn the next generation. This is why pink runs in Washington only occur every other year; there are no one-year-old or three-year-old fish to establish runs in the other years.

Sockeye: *Oncorhynchus nerka*



Picture: US Fish and Wildlife Service

Also known as the redfish, red, or blue-black, they are the most important commercial species. Sockeye have long gill rakers as they primarily feed on plankton when in the ocean. They have the greatest life history diversity and can spend anywhere from 3 months to 3 years in freshwater. They will spawn near shorelines, the bottom of lakes, or hundreds of miles upstream. Fry of this species rear almost exclusively in lakes. While in the ocean they are greenish blue on top of the head and back, silvery on the sides, and white

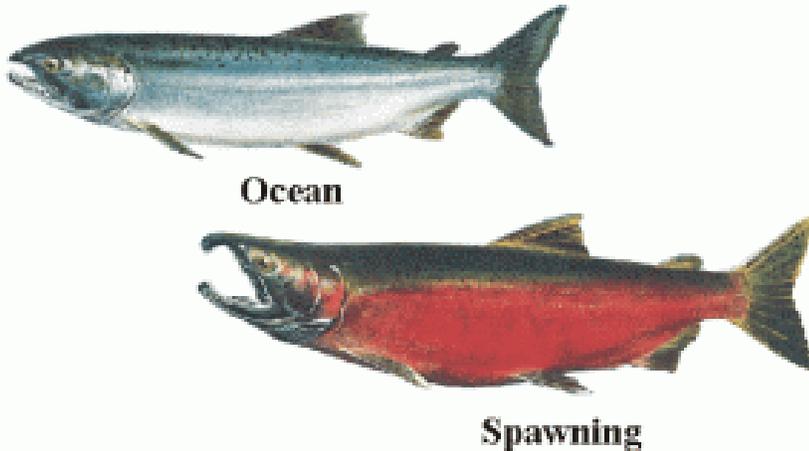
to silver on the belly. During the spawning phase the head and caudal fin become bright green and the body turns scarlet. Land locked populations of this species are known as kokanee. These fish generally live 2-6 years, are about 21-26in in length, and weigh about 4-7lbs.

The sockeye fry migrate downstream to the deep waters of nursery lakes upon emergence from spawning sites, and then rear for 1 or 2 years in a lake habitat before migrating to sea. Lake habitats are especially critical to sockeye. Good water quality and production of food organisms are important because survival in lakes can depend upon how fast sockeye grow to a size that reduces their vulnerability to predators.

Sockeye salmon generally spawn in streams that are tributaries to large lakes. These streams can vary in type, ranging from small tributaries to large mainstem rivers and side-channels. Additionally, some sockeye stocks spawn along the shorelines of lakes. Sockeye spawning begins as early as August and can extend through February.

Large rivers that supplied sufficient room for spawning and rearing historically supported huge runs of sockeye, numbering into the millions. One such run still exists today on the Adams River in British Columbia, a tributary to the Fraser River. The Canadian government has built viewing platforms for visitors, and annual runs of over a million sockeye are common.

Coho: *Oncorhynchus kisutch*



Picture: US Fish and Wildlife Service

Also known as a silver, coho are the second least abundant (following Chinook) salmon. While they are one of the most commercially sought-after species, they make up only 7-10% of the commercial salmon fishery. They spend 1-2 years in freshwater and prefer near shore feeding grounds. Coho usually travel less than 100 miles from the mouth of their stream for reproduction, though a few populations that do travel over a thousand miles. While in the ocean they have dark metallic blue or greenish backs with silver sides and a light belly. They have small black spots on their backs and the upper

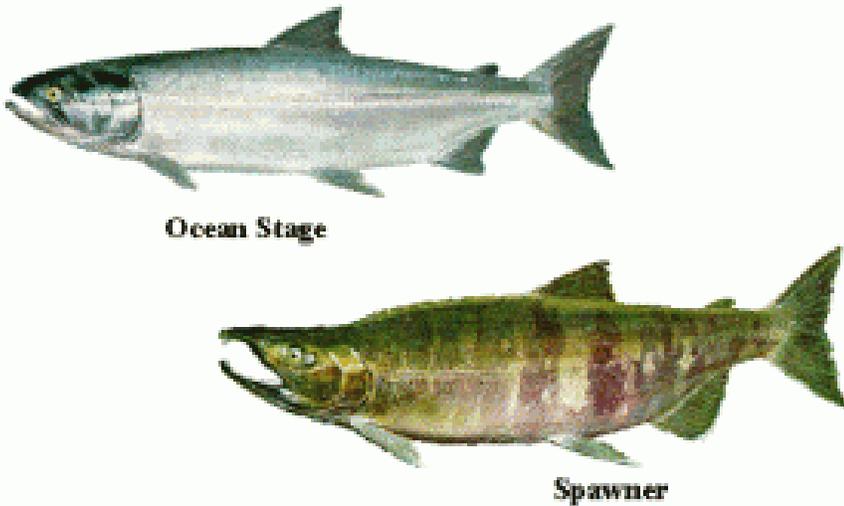
lobe of the tail. Another distinguishing feature is their gum line which is white. Spawning colors are dark with reddish coloration on their sides. These fish generally live 3-5 years, are about 24-28in in length, and weigh about 5-10 lbs.

Coho have a very regular life history. It takes them about 18 months to go from egg to smolt. In the fall they are deposited in gravel as eggs, emerge from the gravel the next spring, and then rear in the stream for a year before making their way to the ocean.

Coho spawn in small coastal streams and the tributaries of larger rivers. They prefer areas of mid-velocity water with small to medium sized gravel. Because they use small streams with limited space, they must use many streams to successfully reproduce. As a result, coho can be found in virtually every small coastal stream with a year-round flow.

Returning coho frequently gather at the mouths of streams and wait for the water flow to rise, often after a rainstorm, before heading upstream. The higher flows and deeper water enable the fish to pass obstacles such as logs or beaver dams that would otherwise be impassable.

Chum: *Oncorhynchus keta*



Picture: US Fish and Wildlife Service

Also known as the dog, or calico salmon. Chum comes from a word meaning variegated coloration. They have the most widely distributed population and the greatest biomass. They are the second largest salmon (following the Chinook). Most populations reproduce near the mouth of their stream. When in the ocean they are metallic, greenish-blue along the back with black speckles which closely resemble sockeye and coho. During the spawning phase males get vertical bars in reds, greens, and purples, while

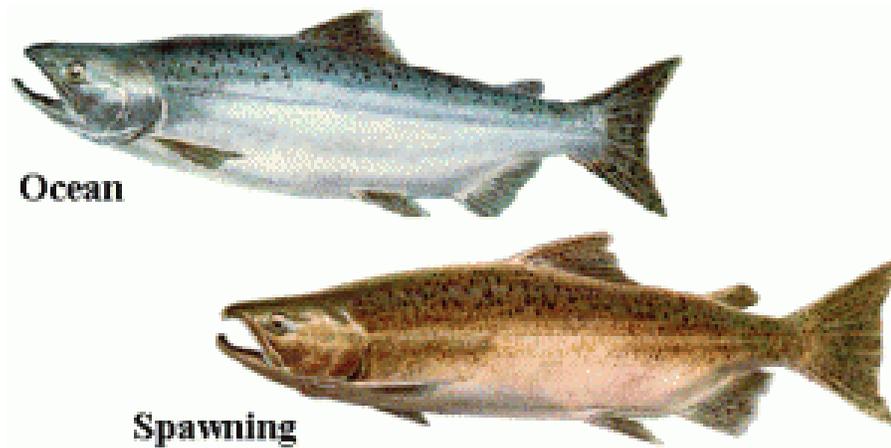
females get a black horizontal stripe. These fish generally live 3-5 years, are 21-31in in length, and weigh about 6.5-12.5lbs.

Chum fry do not rear in freshwater for more than a few days. Shortly after they emerge, chum fry move downstream to the estuary and rear there for several months before heading out to the open ocean.

Chum use small coastal streams and the lower reaches of larger rivers for their spawning grounds. They often use the same streams as coho, but coho tend to move further up the watershed and chum generally spawn closer to saltwater. This may be due to their larger size, which requires deeper water to swim in; or their jumping ability, which is inferior to coho. Either way, the result is a watershed divided between the two species, with all the niches filled.

Like coho, chum can be found in virtually every small coastal stream. In the fall, large numbers of chum can often be seen in the lower reaches of these streams, providing opportunities to view wild salmon in a natural environment.

Chinook: *Oncorhynchus tshawytscha*



Picture: US Fish and Wildlife Service

Also known as the king, tye, or blackmouth, the name Chinook came from the native peoples of the Columbia River and is considered a proper name and thus is always capitalized. They are the largest, but least abundant salmon. When in the ocean they have bluish-green backs and silver sides with irregular spotting on the back, dorsal fin, and both lobes of the tail. Another distinguishing characteristic is their black gum line. Spawning colors

are olive brown to dark brown in color. Males also develop a hooked snout. These fish live about 3-6 years, are 28-40in in length, and weigh about 10-30 lbs.

Depending on the race of chinook and the location, chinook fry rear in freshwater for three months to a year. Spring chinook tend to stay in streams for a full year; fish in northern areas tend to stay in the stream longer as well, primarily because the streams are less productive and growth is slower. Rearing chinook fry use mainstems of rivers as well as their tributaries.

Most chinook spawn in large rivers, such as the Columbia or Snake, although they will also use smaller streams with sufficient water flow. They tend to spawn in the mainstem of streams where the water flow is high. Because of their size they are able to spawn in larger gravel than most salmon.

Chinook spawn on both sides of the Cascade Range, some traveling hundreds of miles upstream to reach their spawning grounds. As a result of the distance needed to travel, these fish enter streams early and comprise the spring and summer runs. Fall runs spawn closer to the ocean and tend to use small coastal streams. All chinook reach their spawning grounds by fall, in time to spawn.

Steelhead: *Oncorhynchus mykiss*



Picture: Trout Unlimited California

Commonly known as the steelhead trout, coastal rainbow trout, silver trout, salmon trout, ironhead, or steelie this salmon has historically been idolized as a trophy game fish. This species consists of a two runs, a winter and a summer. They differ from other salmon species in that they can return multiple times to spawn. However the number of returning spawners decreases significantly from year to year with few fourth year spawners. There is a higher mortality rate during steelhead spawning season as they do not feed while in freshwater. They are characterized by their metallic blue backs and silvery sides, and black spots on the back, dorsal and caudal fins. Spawning colors are darker with males having a pink or

red band on the sides. They do not have a red dash under lower jaw which distinguishes steelhead from coastal cutthroat. These fish live about 1-4 years, are about 20-30 in in length, and weigh about 5-20 lbs.

Steelhead spawn in the spring. They generally prefer fast water in small-to-large mainstem rivers and medium-to-large tributaries. In streams with steep gradient and large substrate, they spawn between these steep areas where the water is flatter and the substrate is small enough to dig into. The steeper areas then make excellent rearing habitats for juveniles.

Like chinook, steelhead have two runs, a summer run and a winter run. Most summer runs are east of the Cascades, and enter streams in summer to reach the spawning grounds by the following spring. A few western Washington rivers also have established runs of summer steelhead. Winter runs spawn closer to the ocean and require less travel time

Steelhead fry emerge from the gravel in summer and generally rear for two or three years in freshwater; occasionally one or four years depending on the productivity of the stream. Streams high in the mountains and those in northern climates are generally less productive. Hatchery Steelhead grow faster and smolt at one year of age..

Fry use areas of fast water and large substrate for rearing. They wait in eddies behind large rocks and allow the river to bring them food in the form of insects, salmon eggs, and smaller fish.

Cutthroat: (*Oncorhynchus clarki clarki*)



PICTURE: US FISH AND WILDLIFE SERVICE

Also known as sea-run cutthroat trout, coastal cutthroat trout, red-throated trout, sea trout, and blueback trout. This species has three life history options: two types spend their entire lives in freshwater while only one type is anadromous. Cutthroat are characterized by a red or orange streak along the inner edge of the lower jaw. They have a greenish blue back tending towards metallic blue, silvery sides, and distinct black spots on the back, head, anal fin, tail, and sides. The spots on the sides extend below the lateral line. These fish live an average of 3-6 years, fourth and fifth year spawners reach 17-19 in in length, and weigh about 1-6 lbs.

Most cutthroat rear in-stream for two to three years before first venturing into salt water. Emerging fry are less than an inch long, and are poorly able to compete with larger coho and steelhead fry for resources. To compensate, cutthroat fry use headwaters and low-flow areas that coho and steelhead avoid.

Unlike other anadromous salmonids that spend multiple years feeding far out to sea, cutthroat prefer to remain within a few miles of their natal stream. They do not generally cross large open-water areas. Some will overwinter in freshwater and only feed at sea during the warmer months. In rivers with extensive estuary systems, cutthroat may move around in the inter-tidal environment feeding, plus run up-river or out to sea on feeding migrations, wherever their nose tells them the food is. Protected estuaries and Puget Sound bays are excellent cutthroat habitat.

Sea-run cutthroat spawn over a long period, from winter through May. They seek smaller streams where the flow is minimal and the substrate is small, almost sand. They prefer the upper-most portions of these streams, areas that are too shallow for other salmonids.

